DOCUMENT RESUME

ED 204 164 SE 035 275

AUTHOR Hungerman, Ann D.
TITLE Contrasts in Achievement of Computational Skills by Low and High Ability Sixth Grade Students in 1965 SMSG and 1975 Modern Elementary Mathematics Programs.
PUB DATE 81
NOTE 43p.

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Comparative Analysis; Educational Research; Elementary Education; *Elementary School Mathematics; Evaluation; *Grade 6; *Individualized Instruction; Learning Theories; *Mathematics Achievement; Mathematics Education; *Mathematics Instruction; Teaching Methods; Testing
IDENTIFIERS *Mathematics Education Research

ABSTRACT

ANOVA and Profile analysis were employed to compare the computational skills of high and low ability sixth graders during a decade of efforts to individualize instruction. Comparison of lowest ability subgroups demonstrated no differences with statistical significance in their computational skills. There were statistically significant differences favoring the 1965 SMSG highest I.Q. subgroup in fraction and decimal addition, subtraction and total. Statistically significant differences favored the 1975 highest I.Q. subgroup in decimal division. Attempts to meet individual differences appear not to have been effective. (Author)

CONTRASTS IN ACHIEVEMENT OF COMPUTATIONAL SKILLS BY LOW AND HIGH ABILITY SIXTH GRADE STUDENTS IN 1965 AND 1975 MODERN ELEMENTARY MATHEMATICS PROGRAMS

Ann D. Hungerman
Professor of Education
The University of Michigan

ANOVA and Profile analysis were employed to compare the computational skills of high and low ability sixth graders during a decade of efforts to individualize instruction. Comparison of lowest ability subgroups demonstrated no differences with statistical significance favoring the 1965 SMSG highest I.Q. subgroup in fraction and decimal addition, substraction and total. The differences favored the 1975 highest I.Q. subgroup in decimal division. Attempts to meet individual differences appear not to have been effective.

INTRODUCTION

Phase III analysis of the computational skills of sixth grade students in 1965 SMSG and 1975 Modern elementary mathematics programs was conducted to investigate further the differences between the achievement of high and low ability students which were reported in Phase II.[1] While Phase I reported differences generally favoring the 1975 Modern group in whole number computation and the 1965 group in fraction and decimal computation, Phase II revealed the 1975 group's advantage to be due mainly to the high I.Q. (equal to or above 106) subgroup. The low I.Q. (below 106) subgroups demonstrated remarkably similar scores in 1965 and 1975.[2]

The increasing concern about individual differences verbalized by educators in the recent decade would lead one to believe that the goal and the result of instructional efforts would be higher achievement by learners at both extremes of the ability scale. Teachers have long been criticized for "teaching to the mean" or the average child, to the detriment of both the gifted learner and the learner with real problems. In this Phase III analysis, the students were further stratified by ability level, assigned to one of four I.Q. subgroups using 91.5, 101.5 and 111.5 as cutoff points. The performances of the lowest and the highest of these four subgroups were analyzed using Analysis of Variance with pairwise comparisons and Scheffe allowances, Profile Analysis and Descriptive Statistics.

Lowest I.Q. Subgroups (I.Q. < 92)

Group	N	Mean	Min	Max
1965 SMSG	76	83.64	65	91
1975 Modern	76	85.16	74	91

(No statistically significant difference)

Highest I.Q. Subgroups (I.Q. ≥ 112)

Group	N	Mean	Min	Max
1965 SMSG	101	119.34	112	134
1975 Modern	95	118.67	112	136

(No statistically significant difference)

What follows is a description of instructional efforts to recognize individual differences in mathematics instruction over the last decade in a southeastern Michigan school system, a report of the most recent analyses of student performance on 80 computational items of the California Arithmetic Test, and some conclusions drawn from the findings.

INSTRUCTIONAL EFFORTS: Textbooks and Individualizing

In 1965, the original year of the study, the SMSG series had been in use for three years in the schools tested. Addison-Wesley was adopted for the 1965-68 period, and in the intervening years the trend has been toward increasing use of multiple texts. In 1975, four series had been identified as "basic texts" and all schools were encouraged to use all four of them. The reality of multiple text use was reported by six teachers who reported use of all four texts (Addison-Wesley, American Book Company, Harcourt Brace and Houghton-Mifflin), four teachers who reported use of three of the four texts, and the eight remaining teachers who reported use of two of the four texts. "Mathematics Prescription Resource Document," a continuous progress format for mathematics education, K-12, is based upon those four textbook series and was developed by a 1971 project team, revised in 1972 by a summer team, and again in 1974 by the six-member Individualized Mathematics Study Committee, with the director of mathematics education as facilitator. The stated philosophy is "to teach each child in such a way as to allow him to succeed at his own rate."

When presented with a variety of ways to meet individual differences, and asked to check any which they were actually using in their classrooms, 16 teachers checked "continuous progress" (for 1-5 years); 13 checked informal ways as well as continuous progress; 2 checked that they meet individual differences without individualizing; and 1 failed to check any of the above.

FINDINGS

Lowest I.Q. subgroups

1. There were no statistically significant differences between the 1965 SMSG and the 1975 Modern lowest I.Q. subgroups on any variable of whole number, fraction or decimal computation, evident in the Anova or Profile analyses.

2. Descriptive statistics revealed some slight differences which were not statistically significant: means were lower in fractions and decimals; maximum scores were higher in whole numbers and fractions; the minimum score was lower in whole numbers and the range for decimals remains unchanged.

Highest I.Q. subgroups

3. There were no statistically significant differences between the highest I.Q. subgroups for any whole number variable.

4. Statistically significant differences favored the 1965 SMSG highest I.Q. subgroup over their 1975 Modern counterpart in:

   fraction additon .0081
   9900 level Scheffe allowance

   fraction subtraction .0001
   9900 level Scheffe allowance

   fraction total 10082
   9500 level Scheffe allowance

   decimal addition .0000
   9900 level Scheffe allowance

   decimal subtraction .0000
   9900 level Scheffe allowance

   decimal total .0003
   9900 level Scheffe allowance

   Profile analysis supported the advantage of the 1965 SMSG highest I.Q. subgroup in decimals; in fractions it displayed statistically significantly different profiles, but not statistically significantly different group differences for the combination of all four fraction operations. All of these differences were small.

5. Statistically significant differences favored the 1975 Modern highest I.Q. subgroup over their 1965 SMSG counterparts in decimal division (.0032, 9500 level Scheffe allowance).

6. Descriptive statistics for the 1975 Modern highest I.Q. subgroup listed lower means for fraction and decimal totals and a higher (not statistically significant) mean for whole numbers. The minimum and maximum scores were lower for fractions and unchanged (already the complete range, 0-8) in decimals.

Lowest-Highest Comparison

7. Descriptive statistics revealed an overlap of score ranges by the lowest and highest I.Q. groups as follows:

		Low I.Q. Max	High I.Q. Min
COMP-TOT (80)	SMSG	56	25
	TRAD	58	29
	MOD	59	27
WN-TOT (33)	SMSG	31	15
	TRAD	32	17
	MOD	33	19
FR-TOT (30)	SMSG	19	6
	TRAD	19	4
	MOD	20	3
DEC-TOT	SMSG	5	0
	TRAD	4	0
	MOD	5	0

CONCLUSIONS

The data reported here clearly indicate that the goal of higher computational skill achievement by most and least able learners has not been reached. The 1965 SMSG and 1975 Modern lowest I.Q. subgroups demonstrated no differences in any area of elementary mathematics computational skills. The 1975 Modern highest I.Q. subgroup had the advantage only in decimal division (an atypical finding which may be attributed to recency of instruction), while yielding an advantage in addition and subtraction of fractions and decimals to their 1965 SMSG counterparts. Thus the least able learners have made no progress and the most able learners are doing even less well than ten years ago.

DISCUSSION

Most educators readily admit the shortcomings of recent attemps to reform curriculum through changes in content and patterns of organizing for instruction. Furthermore, the data on overlapping ranges of scores by the highest and lowest ability students offer us dramatic reminders that ability alone, even the highest, is not a guarantee of achievement, and that I.Q.

scores, even the lowest, are not infallible predictors of failure. Sequencing the content is not enough. "Allowing" a child "to succeed at his own rate," is not enough. Future success in improving the computational skills of all-ability students is much more likely to be a product of more effective instruction and of more efficient review and drill precedures. This focuses the spotlight back upon the teacher and highlights the need for more effective staff development programs.

FOOTNOTES

1. Part I of this research report was published in the Mathematics Education Information Report, "Research Sections National Council of Teachers of Mathematics 55th Annual Meeting, Cincinnati, Ohio, April 20-23, 1977," ERIC-SMEAC: Ohio State University, Columbus, Ohio, December 1976.

2. Phase II analysis is reported in ERIC document ED 144839.

DESCRIPTIVE STATISTICS:
STATIFIED I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN

GROUP	I.Q. SUBGP	N	MEAN I.Q.	RANGE	S.D.
1965 SMSG	LO	76	83.645*	65- 91	6.00
	MIDLO	71	96.90	92-101	3.00
	MIDHI	57	106.18	102-111	2.58
	HI	101	119.34**	112-134	6.24
		305			
1975 MODERN	LO	75	85.16*	74- 91	4.60
	MIDLO	89	96.40	92-101	2.93
	MIDHI	127	106.20	102-111	2.59
	HI	95	118.67**	112-136	5.51
		386			

*The 1965 and 1975 lowest I.Q. subgroups did not differ with statistical significance.

**The 1965 and 1975 highest I.Q. subgroups did not differ with statistical significance.

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF LOWEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

VAR (ITEM N)	GP-N		MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* 9500	SCHEFFE* 9900
I.Q. TOTAL (92)	SMSG-LO	76	83.645	6.0	-1.5153	2.4	.1219	2.4063	2.9967
	MOD-LO	75	85.160	4.6					
COMPUTATION (80)	SMSG-LO	76	33.684	10.088	1.4842	.87031	.3521	3.9264	4.8897
	MOD-LO	75	32.200	9.5266					
ADD (20)	SMSG-LO	76	9.9211	3.0321	.65439	1.8831	.1717	1.1769	1.4656
	MOD-LO	75	9.2667	2.6475					
SUB (20)	SMSG-LO	76	9.0263	2.9073	.37298	.61427	.4342	1.1745	1.4626
	MOD-LO	75	8.6533	2.7680					
MULT (20)	SMSG-LO	76	7.5658	3.5975	.36579	.50392	.4787	1.2717	1.5837
	MOD-LO	75	7.2000	2.8805					
DIV (20)	SMSG-LO	76	7.1711	2.6502	.09105	.03572	.8503	1.1888	1.4805
	MOD-LO	75	7.0800	3.3562					

*Statistical significance was not indicated for any of the 20 variables.

**I.Q. lower than 92

KEY: WN Whole Number
F Fraction
D Decimal

ADD Addition
SUB Subtraction
MULT Multiplication
DIV Division

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF LOWEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

(Continued)

VAR (ITEM N)	GP-N	MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* .9500	SCHEFFE* .9900
WN:ADD (7)	SMSG-LO 76	6.0263	1.2326	-.35088	.29182-5	.9986	.50691	.63128
	MOD-LO 75	6.0267	1.1505					
WN:SUB (7)	SMSG-LO 76	5.3026	1.5407	.06263	.05650	.8124	.65028	.80983
	MOD-LO 75	5.2400	1.3837					
WN:MULT (9)	SMSG-LO 76	5.2895	2.4594	.11614	.09955	.7527	.90843	1.1313
	MOD-LO 75	5.1733	2.0360					
WN:DIV (10)	SMSG-LO 76	4.9079	2.3162	-.15877	.18436	.6682	.91258	1.1365
	MOD-LO 75	5.0667	2.2621					
WN:TOTAL (33)	SMSG-LO 76	21.526	5.7746	.01964	.46288-3	.9829	2.2539	2.8069
	MOD-LO 75	21.507	4.9712					

*Statistical significance was not indicated for any of the 20 variables.

**I.Q. lower than 92

KEY: WN Whole Number; F Fraction; D Decimal; ADD Addition; SUB Subtraction; MULT Multiplication; DIV Division

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF LOWEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

(Continued)

VAR (ITEM N)	GP-N	MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* 9500	SCHEFFE* 9900
F:ADD (7)	SMSG-LO 76	2.6974	2.0463	.65737	4.2530	.0406	.78667	.97968
	MOD-LO 75	2.0400	1.8559					
F:SUB (7)	SMSG-LO 76	2.6053	1.5755	.21860	.70395	.4026	.64299	.80075
	MOD-LO 75	2.3867	1.5759					
F:MULT (8)	SMSG-LO 76	1.6447	1.5808	.19140	.69007	.4072	.56864	.70816
	MOD-LO 75	1.4533	1.2225					
F:DIV (8)	SMSG-LO 76	1.7895	1.2035	.29614	1.8554	.1748	.53665	.66820
	MOD-LO 75	1.4933	1.4178					
F:TOTAL (30)	SMSG-LO 76	8.7368	4.3677	1.3635	3.6900	.0563	1.7518	2.1816
	MOD-LO 75	7.3733	4.6551					

*Statistical significance was not indicated for any of the 20 variables.

**I.Q. lower than 92

KEY:

WN Whole Number
F Fraction
D Decimal

ADD Addition
SUB Subtraction
MULT Multiplication
DIV Division

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF LOWEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

(Concluded)

VAR (ITEM N)	GP-N	MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* 9500	SCHEFFE* 9900
D:ADD (2)	SMSG-LO 76	.34211	.60117	.08877	.97249	.3254	.22216	.27667
	MOD-LO 75	.25333	.49575					
D:SUB (2)	SMSG-LO 76	.34211	.53047	.03543	.18174	.6704	.20516	.25549
	MOD-LO 75	.30667	.51918					
D:MULT (2)	SMSG-LO 76	.60526	.54354	.08526	.81498	.3678	.23309	.29028
	MOD-LO 75	.52000	.55410					
D:DIV (2)	SMSG-LO 76	.46053	.57598	.05947	.36861	.5445	.24175	.30107
	MOD-LO 75	.52000	.66495					
D:TOTAL (8)	SMSG-LO 76	1.7500	1.2450	.15000	.53815	.4641	.50463	.62844
	MOD-LO 75	1.6000	1.3557					

*Statistical significance was not indicated for any of the 20 variables.

**I.Q. lower than 92

KEY: WN Whole Number; F Fraction; D Decimal; ADD Addition; SUB Subtraction; MULT Multiplication; DIV Division

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF HIGHEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

VAR (ITEM N)	GP-N		MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* 9500	SCHEFFE* 9900
I.Q. TOTAL (135)	SMSG-HI	101	119.34	6.2390	.66295	.63009	.4280	2.0546	2.5543
	MOD-HI	95	118.67	5.5091					
COMPUTATION (80)	SMSG-HI	101	54.970	11.440	2.9598	4.1154	.0434	3.5892	4.4622
	MOD-HI	95	52.011	10.393					
ADD (20)	SMSG-HI	101	15.584	3.0992	1.2999	9.6763	.0020*	1.0281*	1.2781*
	MOD-HI	95	14.284	3.0931					
SUB (20)	SMSG-HI	101	15.089	3.5046	1.7102	15.880	.0001*	1.0558*	1.3125*
	MOD-HI	95	13.379	2.9900					
MULT (20)	SMSG-HI	101	12.426	3.6588	.34153	.54226	.4621	1.1410	1.4185
	MOD-HI	95	12.084	2.8683					
DIV (20)	SMSG-HI	101	11.851	3.2292		.81112	.3685	1.1245	1.3980
	MOD-HI	95	12.263	3.1932	-.41167				

*Statistical significance at level indicated

**I.Q. $\geq$ 112

KEY: WN Whole Number; F Fraction; D Decimal

ADD Addition; SUB Subtraction; MULT Multiplication; DIV Division

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF HIGHEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

(Continued)

VAR (ITEM N)	GP-N	MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* 9500	SCHEFFE* 9900
WN:ADD (7)	SMSG-HI 101	6.6733	.60181	.01011	.01270	.9104	.22069	.27437
	MOD-HI 95	6.6632	.66221					
WN:SUB (7)	SMSG-HI 101	6.1386	1.1228		5.5628	.0190	.31656	.39355
	MOD-HI 95	6.4421	.83431	-.30349				
WN:MULT (9)	SMSG-HI 101	7.2970	1.7120		3.8027	.0521	.50173	.62377
	MOD-HI 95	7.6947	1.2123	-.39771				
WN:DIV (10)	SMSG-HI 101	7.7129	1.6145		.57062	.4506	.59228	.73634
	MOD-HI 95	7.8947	1.6077	-.18187				
WN:TOTAL (33)	SMSG-HI 101	27.822	3.8010		3.4281	.0651	1.1599	1.4420
	MOD-HI 95	28.695	3.3392	-.87295				

*Statistical significance at level indicated

**I.Q. $\geq$ 112

KEY: WN Whole Number; F Fraction; D Decimal

ADD Addition; SUB Subtraction; MULT Multiplication; DIV Division

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF HIGHEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

(Continued)

VAR (ITEM N)	GP-N	MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* 9500	SCHEFFE* 9900
F:ADD (7)	SMSG-HI 101	5.6832	1.5807	.59896	7.1052	.0081*	.55279*	.68724
	MOD-HI 95	5.0842	1.8661					
F:SUB (7)	SMSG-HI 101	5.5545	1.5778	.81761	14.940	.0001*	.52039*	.64696*
	MOD-HI 95	4.7368	1.5657					
F:MULT (8)	SMSG-HI 101	3.9703	2.1562	.60188	3.9273	.0484	.74716	.92889
	MOD-HI 95	3.3684	2.0476					
F:DIV (8)	SMSG-HI 101	3.4653	1.9523	.01271	.00196	.9647	.70588	.87745
	MOD-HI 95	3.4526	1.9448					
F:TOTAL (30)	SMSG-HI 101	18.673	5.4628	2.0312	7.0891	.0082*	1.8767*	2.3332
	MOD-HI 95	16.642	5.7463					

*Statistical significance at level indicated

**I.Q. $\geq$ 112

KEY: WN Whole Number; F Fraction; D Decimal

ADD Addition; SUB Subtraction; MULT Multiplication; DIV Division

ANALYSIS OF VARIANCE WITH PAIRWISE COMPARISONS: SCORES OF HIGHEST** I.Q. SUBGROUPS, 1965 SMSG AND 1975 MODERN, FOR 20 COMPUTATION VARIABLES

(Concluded)

VAR (ITEM N)	GP-N	MEAN	S.D.	DIFF	F-STAT	SIG*	SCHEFFE* 9500	SCHEFFE* 9900
D:ADD (2)	SMSG-HI 101	1.0594	.85816	.53309	20.637	.0000*	.28869*	.35890*
	MOD-HI 95	.52632	.76967					
D:SUB (2)	SMSG-HI 101	.98020	.82438	.55915	31.574	.0000*	.24480*	.30434*
	MOD-HI 95	.42105	.61157					
D:MULT (2)	SMSG-HI 101	.92079	.73052	.14184	2.4411	.1193	.22334	.27766
	MOD-HI 95	.77895	.60457					
D:DIV (2)	SMSG-HI 101	.66337	.62092		8.8583	.0032*	.22605*	.28102
	MOD-HI 95	.93684	.78294	-.27348				
D:TOTAL (8)	SMSG-HI 101	3.6238	1.9123	.95060	13.698	.0003*	.63852*	.79383*
	MOD-HI 95	2.6632	1.9926					

*Statistical significance at level indicated

**I.Q. $\geq$ 112

KEY: WN Whole Number; F Fraction; D Decimal

ADD Addition; SUB Subtraction; MULT Multiplication; DIV Division

PROFILE ANALYSIS: 1965 SMSG AND 1975 MODERN, LOWEST* AND HIGHEST I.Q. SUBGROUP PERFORMANCE ON SELECTED COMBINATIONS OF COMPUTATION VARIABLES

	VARIABLE COMBINATION**	H1:PARALLELISM SIG		H2:EQ VAR MEANS SIG		H3:NO STRATA DIFF SIG	
Comparison of 1965 SMSG Lowest I.Q. with 1975 Modern Lowest I.Q. subgroups							
1.	A,S,M,D	Profiles do not differ	.6800	Variable means differ	.0000	Groups do not differ	.3536
2.	WN:A,S,M,D	Profiles do not differ	.8796	Variable means differ	.0000	Groups do not differ	.9822
3.	F:A,S,M,D	Profiles do not differ	.4334	Variable means differ	.0000	Groups do not differ	.0654
4.	D:A,S,M,D	Profiles do not differ	.6410	Variable means differ	.0000	Groups do not differ	.4799
Comparison of 1965 SMSG Highest I.Q. with 1975 Modern Highest I.Q. subgroups							
5.	A,S,M,D	Profiles differ	.0000	Variable means differ	.0000	Groups do not differ	.0623
6.	WN:A,S,M,D	Profiles do not differ	.0860	Variable means differ	.0000	Groups do not differ	.0725
7.	F:A,S,M,D	Profiles do not differ (except at p <.03 level)	.0255	Variable means differ	.0000	Groups differ (at p <.02 level only) 1965 >1975 in A,S,T	.0120
8.	D:A,S,M,D	Profiles differ	.0000	Variable means do not differ (small item N)	.1690	Groups differ 1965 > 1975 in A,S,T 1975 > 1965 in D	.0007

*Lowest: I.Q. lower than 92, Highest: I.Q. $\geq$ 112

**Key: WN - Whole Number, F - Fraction, D - Decimal; A - Addition, S - Subtraction, M - Multiplication, D - Division, T - Total

PROFILE ANALYSIS: 1965 SMSG AND 1975 MODERN, LOWEST* AND HIGHEST I.Q. SUBGROUP PERFORMANCE ON SELECTED COMBINATIONS OF COMPUTATION VARIABLES

	VARIABLE COMBINATION**	H1:PARALLELISM SIG		H2:EQ VAR MEANS SIG		H3:NO STRATA DIFF SIG	
	Comparison of 1965 Lowest I.Q. with 1965 Highest I.Q. subgroups						
9.	A,S,M,D	Profiles differ (only at p <.02 level)	.0101	Variable means differ	.0000	Groups differ	.0000
10.	WN:A,S,M,D	Profiles differ	.0000	Variable means differ	.0000	Groups differ	.0000
11.	F:A,S,M,D	Profiles differ	.0004	Variable means differ	.0000	Groups differ	.0000
12.	D:A,S,M,D	Profiles differ	.0013	Variable means differ	.0078	Groups differ	.0000
	Comparison of 1975 Lowest I.Q. with 1975 Highest I.Q. subgroups						
13.	A,S,M,D	Profiles do not differ	.7015	Variable means differ	.0000	Groups differ	.0000
14.	WN:A,S,M,D	Profiles differ	.0000	Variable means differ	.0000	Groups differ	.0000
15.	F:A,S,M,D	Profiles differ	.0017	Variable means differ	.0000	Groups differ	.0000
16.	D:A,S,M,D	Profiles do not differ (distorted visual appears to differ)	.1143	Variable means differ	.0000	Groups differ	.0001

*Lowest: I.Q. lower than 92, Highest: I.Q. $\geq$ 112

**Key:
WN - Whole Number
F - Fraction
D - Decimal
A - Addition
S - Subtraction
M - Multiplication
D - Division

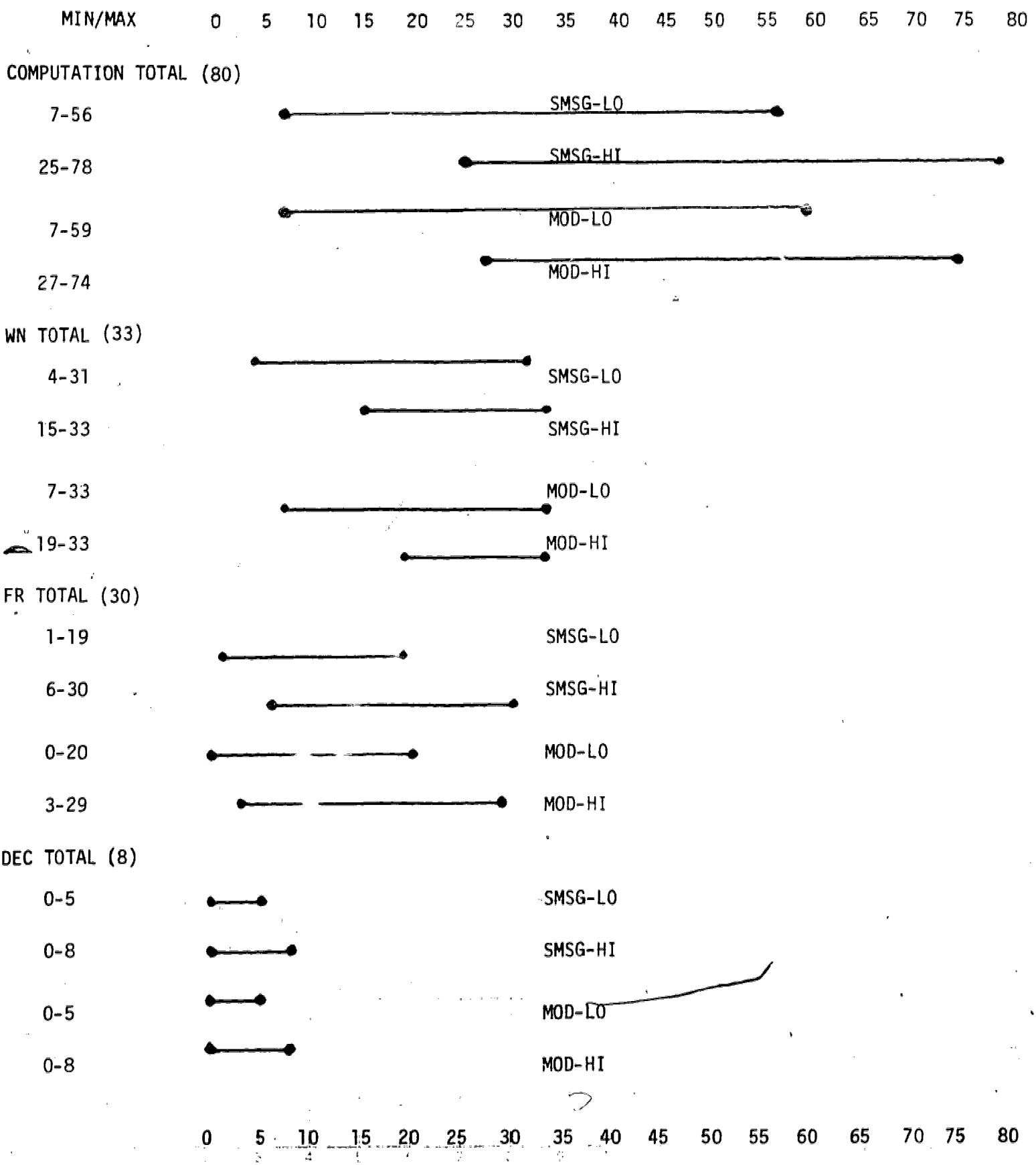
PROFILE ANALYSIS: 1965 SMSG AND 1975 MODERN, FOUR-STRATA* I.Q. SUBGROUP PERFORMANCE ON SELECTED COMBINATIONS OF COMPUTATION VARIABLES

	VARIABLE COMBINATION**	H1:PARALLELISM SIG		H2:EQ VAR MEANS SIG		H3:NO STRATA DIFF SIG	
Comparison of 1965 Lowest, Midlow, Midhigh, and Highest I.Q. subgroups							
17.	A,S,M,D	Profiles do not differ	NS @.05	Variable means differ	.0000	Groups differ	.0000
18.	WN:A,S,M,D	Profiles differ (subgroup relative order differs, A, M from S,D)	.0000	Variable means differ	.0000	Groups differ	.0000
19.	F:A,S,M,D	Profiles differ	.0069	Variable means differ	.0000	Groups differ	.0000
20.	D:A,S,M,D	Profiles differ (subgroups are in relatively different order for each operation)	.0079	Variable means differ	.0001	Groups differ	.0000
Comparison of 1975 Lowest, Midlow, Midhigh, and Highest I.Q. subgroups							
21.	A,S,M,D	Profiles do not differ	NS @.05	Variable means differ	.0000	Groups differ	.0000
22.	WN:A,S,M,D	Profiles differ	.0000	Variable means differ	.0000	Groups differ	.0000
23.	F:A,S,M,D	Profiles differ	.0027	Variable means differ	.0000	Groups differ	.0000
24.	D:A,S,M,D	Profiles do not differ	NS @.05	Variable means differ	.0000	Groups differ	.0002

*Cutoff points 91.5, 101.5 and 111.5 yield lowest, midlow, midhigh, and highest I.Q. subgroups.

**Key: WN - Whole Number, F - Fraction, D - Decimal; A - Addition, S - Subtraction, M - Multiplication, D - Division

OVERLAP OF COMPUTATION SCORE RANGES, HIGHEST AND LOWEST I.Q. STUDENTS, SMSG AND MODERN



<PROFILE VAR=5,6,7,8 STRAT=V102*V103:1>

<4> IQ GROUP:HIGH*GROUP:SMSG65

PROFILE ANALYSIS

<1> IQ GROUP:LOW*GROUP:SMSG65 <2> IQ GROUP:MIDLOW*GROUP:SMSG65 <3> IQ GROUP:MIDHI*GROUP:SMSG65

5.
ADD 20 1 2 3 4

6.
SUBTRACT 1 2 3 4
20

7.
MULTIPLY 1 2 3 4
20

8.
DIVIDE 1 2 3 4
20

+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+

7.1711 9.0406 10.910 12.780 14.649 MEANS

8.1058 9.9754 11.845 13.715 15.584

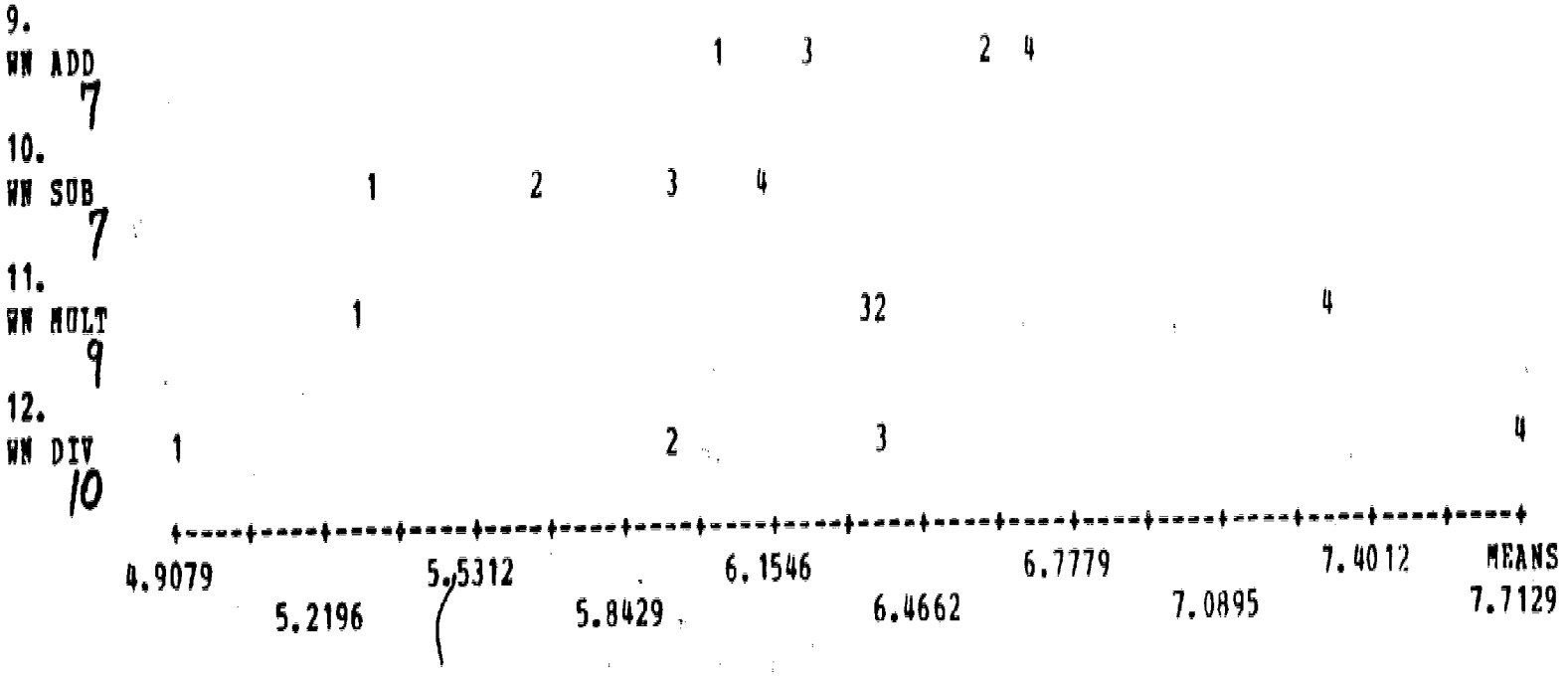
STRATA	<1>	<2>	<3>	<4>
SYMBOL	"1"	"2"	"3"	"4"
N	76	71	57	101

TESTS FOR:	T-SQUARE	F-STAT	DF	SIGNIF
PARALLELISM OF PROFILES	MAX ROOT= .41196 -1		3,-.5,148.5	NS@.05
EQUALITY OF VARIABLE MEANS	385.65	127.70	3, 299	.0000
NO STRATA DIFFERENCES		60.479	3, 301	.0000

#639902-17

<PROFILE VAR=9-12 STRAT=SAME>

PROFILE ANALISIS
<1> IQ GROUP:LOW*GROUP:SMSG65 <2> IQ GROUP:MIDLOW*GROUP:SMSG65 <3> IQ GROUP:MIDHI*GROUP:SMSG65 <4> IQ GROUP:HIGH*GROUP:SMSG65



STRATA	<1>	<2>	<3>	<4>
SYMBOL	"1"	"2"	"3"	"4"
N	76	71	57	101

TESTS FOR:	T-SQUARE	F-STAT	DF	SIGNIF
PARALLELISM OF PROFILES	MAX ROOT= .22234		3,-.5,148.5	.0000
EQUALITY OF VARIABLE MEANS	70.647	23.393	3, 299	.0000
NO STRATA DIFFERENCES		27.050	3, 301	.0000

#639902-18

<PROFILE VAR=14-17 STRAT=SAME>

<4> IQ GROUP:HIGH*GROUP:SMSG65

PROFILE ANALYSIS

<1> IQ GROUP:LOW*GROUP:SMSG65 <2> IQ GROUP:MIDLOW*GROUP:SMSG65 <3> IQ GROUP:MIDHI*GROUP:SMSG65

14.
RN F ADD 7 1 2 3 4

15.
RN F SUB 7 1 2 3 4

16.
RN F MUL 8 1 2 3 4

17.
RN F DIV 8 1 2 3 4

```
+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
1.6447              2.5422              3.4396              4.3370              5.2345    MEANS
          2.0935              2.9909              3.8883              4.7857              5.6832
```

STRATA	<1>	<2>	<3>	<4>
SYMBOL	"1"	"2"	"3"	"4"
N	76	71	57	101

TESTS FOR:	T-SQUARE	F-STAT	DF	SIGNIF
PARALLELISM OF PROFILES	MAX ROOT= .61971 -1		3,-.5,148.5	.0069
EQUALITY OF VARIABLE MEANS	224.95	74.485	3, 299	.0000
NO STRATA DIFFERENCES		56.830	3, 301	.0000

#639902-19

```
<PROFILE VAR=19-22 STRAT=SAME>
                                                        (4) IQ GROUP:HIGH*GROUP:SMSG65

PROFILE ANALYSIS
(1) IQ GROUP:LOW*GROUP:SMSG65  (2) IQ GROUP:MIDLOW*GROUP:SMSG65  (3) IQ GROUP:MIDHI*GROUP:SMSG65

19.
RN D ADD   1                          2    3                                          4
     2
20.
RN D SUB   1     3                    2                                    4
     2
21.
RN D MUL                         3       1       2                              4
     2
22.
RN D DIV          2      1 3                    4
     2
        +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
      .34211             .50151             .66091             .82031             .97971     MEANS
               .42181             .58121             .74061             .90001             1.0594

STRATA   (1)    (2)    (3)    (4)
SYMBOL   "1"    "2"    "3"    "4"
N        76     71     57     101


TESTS FOR:                    T-SQUARE  F-STAT      DF       SIGNIF

 PARALLELISM OF PROFILES   MAX ROOT= .60863 -1   3,-.5,148.5    .0079
 EQUALITY OF VARIABLE MEANS     21.190    7.0164      3, 299     .0001
 NO STRATA DIFFERENCES                   24.342      3, 301     .0000          #639902-20


(STOP>
```

<PROFILE VAR=5-8 STRAT=V103:3*V107>

<4> GROUP:M1975*IQ GROUP:HIGH

PROFILE ANALYSIS

<1> GROUP:M1975*IQ GROUP:LOW <2> GROUP:M1975*IQ GROUP:MIDLOW <3> GROUP:M1975*IQ GROUP:MIDHI

5.
ADD 20

1 2 3 4

6.
SUBTRACT 20

1 2 3 4

7.
MULTIPLY 20

1 2 3 4

8.
DIVIDE 20

1 2 3 4

+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+

7.0800 8.6809 10.282 11.893 13.484 MEANS

7.8805 9.4814 11.082 12.693 14.284

STRATA	<1>	<2>	<3>	<4>
SYMBOL	"1"	"2"	"3"	"4"
N	75	89	127	95

TESTS FOR:	T-SQUARE	F-STAT	DF	SIGNIF
PARALLELISM OF PROFILES	MAX ROOT= .11722 -1	3,-5.189.0		NS@.05
EQUALITY OF VARIABLE MEANS	249.64	82.778	3, 380	.0000
NO STRATA DIFFERENCES		43.995	3, 382	.0000

#664422-21

<PROFILE VAR=9-12 STRAT=V103:3*V102>

<4> GROUP:M1975*IQ GROUP:HIGH

PROFILE ANALYSIS

<1> GROUP:M1975*IQ GROUP:LOW <2> GROUP:M1975*IQ GROUP:MIDLOW <3> GROUP:M1975*IQ GROUP:MIDHI

9.
WN ADD 7 1 2 3 4

10.
WN SUB 7 1 2 3 4

11.
WN MULT 9 1 2 3 4

12.
WN DIV 10 1 2 3 4

5.0667	5.6951	6.3236	6.9520	7.5805	MEANS
5.3809	6.0094	6.6378	7.2663	7.8947	

STRATA	<1>	<2>	<3>	<4>
SYMBOL	"1"	"2"	"3"	"4"
N	75	89	127	95

TESTS FOR:		T-SQUARE	F-STAT	DF	SIGNIF
PARALLELISM OF PROFILES	MAX ROOT= .25343		3,-5,189.0	.0000
EQUALITY OF VARIABLE MEANS		97.554	32.348	3, 380	.0000
NO STRATA DIFFERENCES			58.260	3, 382	.0000

#664422-22

<PROFILE VAR=14-17 STRAT=V102:3*V102>

<4> GROUP:M1975*IQ GROUP:HIGH

PROFILE ANALYSIS

<1> GROUP:M1975*IQ GROUP:LOW <2> GROUP:M1975*IQ GROUP:MIDLOW <3> GROUP:M1975*IQ GROUP:MIDHI

14.
RN F ADD 1 2 3 4
7

15.
RN F SUB 1 2 3 4
7

16.
RN F MUL 1 2 3 4
8

17.
RN F DIV 1 2 3 4
8

1.4533 2.2602 3.0671 3.8739 4.6808 MEANS
1.8568 2.6636 3.4705 4.2773 5.0842

STRATA	<1>	<2>	<3>	<4>
SYMBOL	"1"	"2"	"3"	"4"
N	75	89	127	95

TESTS FOR:	T-SQUARE	F-STAT	DF	SIGNIF
PARALLELISM OF PROFILES	MAX ROOT= .54817 -1	3,-5,189.0		.0027
EQUALITY OF VARIABLE MEANS	259.68	86.108	3, 380	.0000
NO STRATA DIFFERENCES		47.636	3, 382	.0000

#664422-23

<PROFILE VAR=13-22 STRAT=V103:3*V102>

<4> GROUP:M1975*IQ GROUP:HIGH

PROFILE ANALYSIS

<1> GROUP:M1975*IQ GROUP:LOW <2> GROUP:M1975*IQ GROUP:MIDLOW <3> GROUP:M1975*IQ GROUP:MIDHI

10.
RN D ADD 1 2 3 4
2

20.
RN D SUB 1 X 4
2

21.
RN D MUL 1 2 X
2

22.
RN D DIV 1 2 3 4
2

+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+

.25333 .40522 .55712 .70901 .86090 MEANS

.32928 .48117 .63306 .78495 .93684

STRATA	<1>	<2>	<3>	<4>
SYMBOL	"1"	"2"	"3"	"4"
N	75	89	127	95

TESTS FOR:	T-SQUARE	F-STAT	DF	SIGNIF
PARALLELISM OF PROFILES	MAX ROOT= .16404 -1		3,-.5,189.0	NS@.05
EQUALITY OF VARIABLE MEANS	123.36	40.904	3, 390	.0000
NO STRATA DIFFERENCES		6.7997	3, 382	.0002

#664422-24